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## THE SYNONYMY, VARIABILITY AND BIOLOGY OF *LYCAENA NIVALIS*

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*Lycaena nivalis* Bdv. is a very interesting species in several ways. (1) Its synonymy has been somewhat confused; (2) it is quite variable, which may explain the confusion of names; and (3) its life history was described more than 50 years ago in the Canadian Entomologist, but this fact has gone unrecognized, again because of confusion of names.

*L. nivalis*, and its subspecies *browni* Dos Passos, occurs, according to Clench (1961), "from southern British Columbia south to Colorado, Utah and the middle Sierras of California." Llewellyn Jones (1951) says it is found in British Columbia in the Southern Interior and the Kootenays, in other words, the entire area between the Fraser River and Alberta north to about latitude 52°. In Washington the writer has taken it in Okanogan, Yakima and Klickitat Counties, and it is particularly abundant in Yakima County. Leighton (1946) records it from Leavenworth, which is in Chelan County, and it should also occur in the intervening Kittitas County and perhaps elsewhere in the state.

In Oregon the writer has taken it on Mt. Ashland, Jackson County; at Tombstone and Lost Prairies, Linn County, which are just west of the Cascade summit at Santiam Pass; in the Ochoco and Maury Mountains, Crook County; and in the Warner Mountains, Lake County. In California he collected it years ago just north of Lake Tahoe and more recently just west of Ebbet Pass, Stanislaus County, and in the Warner Mountains, Modoc County. Comstock (1927) says it occurs "at high elevations throughout the Sierras." Brown (1957) records the species from northern and western Wyoming and northern Utah, and the subspecies *browni* from southern Idaho, northwestern Colorado and southeastern Wyoming. The writer has taken it at Aspen Grove, Utah County, Utah.

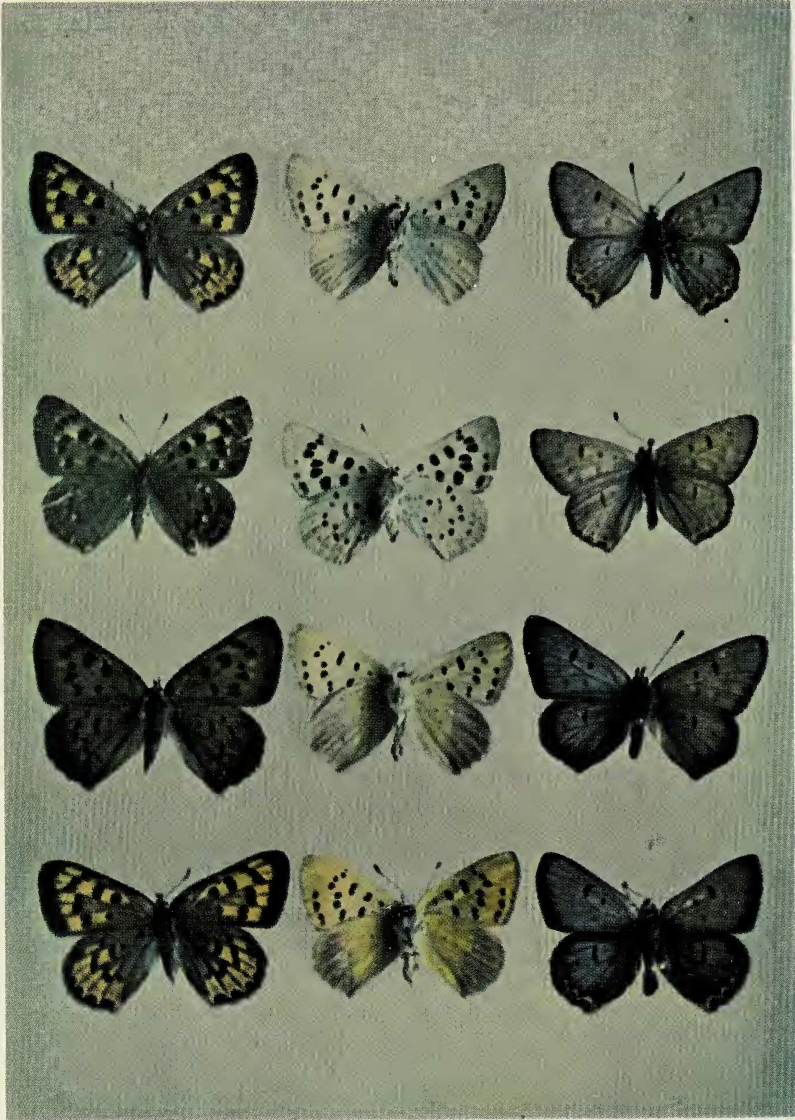


Fig. 1. *Lycaena* from Oregon and Washington. a. Typical *Lycaena nivalis*. Maury Mts., Crook Co., Oregon. b. Similar but females melanic, and black spots below, more pronounced. Camas Creek, Warner Mts., Oregon. c. Typical *L. n. browni*. Bear Canyon, Yakima Co., Wash. d. Similar below, but colors more intense; females with very little melanism. Cascade Mts., Oregon.

## SYNONYMY

Edwards (1877) listed *nivalis* as a synonym of *mariposa* and *ianthe* as a synonym of *zeroe*, and this synonymy was followed by Dyar (1902). Barnes & McDunnough (1917) listed *zeroe* as a synonym of *mariposa* and *ianthe* as a synonym of *nivalis*, and this synonymy has been used by Comstock (1927) and Holland (1931). Holland's original Butterfly Book (1904) did not recognize *nivalis*, *ianthe* or *zeroe* at all. Wright (1907) figured what is certainly *nivalis* but called it *zeroe*.

The writer has referred to the original descriptions of *ianthe*, *nivalis* and *zeroe*<sup>1</sup>, and it is difficult to see how some of this synonymy came about. Edwards (1871), in describing *ianthe*, says in part: "Underside pale buff much powdered at base with grey; primaries have a marginal series of rounded brown spots, obsolete apically, suffused near inner angle with fulvous; a median tortuous row of brown spots or points; a bar on arc, a large round spot below cell. Secondaries have a marginal series of orange crenations, obsolete toward outer angle; a medium row of black dots; an obsolete discal streak; a point in cell and another below." This certainly describes *nivalis*, so that Barnes & McDunnough were correct in making *ianthe* synonymous with that species.

Boisduval's (1869) description of *nivalis* is in Latin and French, and it may be translated into English about as follows:

Upper side of wings darkly fulvous, middle lunules black, shot with iridescent purple; posterior marginal band fulvous; fore wings below pale ochraceous with black spots; hind wings pale, lunules ferruginous.

It looks something like our *hiere* but is very small. The fore wings of the male are a smoky fawn with a beautiful violet reflection. Each wing is marked in the middle with a blackish lunule and with several obsolescent spots faintly visible; below there is a small crenelated band at the margin of ferruginous fawn, bordered behind by black lunules. Below, the fore wings are yellow-ochre, very pale, with black spots as in our species; the secondaries are rosy-yellow, a little glaucous at the base, with some small black spots scarcely indicated, and a series of marginal, obsolete fawn-colored lunules. The female is a clear yellow-fawn, spotted as in other species of the group. Below, it does not differ from the male. This species is very distinct, and similar to *heloïdes*. It is found in the Sierras.

*Nivalis*, meaning "belonging to the snow," is an appropriate name for the species, as it occurs only in areas where there is considerable, and sometimes very heavy, snowfall.

Boisduval's (1869) description of *zeroe*, again in Latin and French, may be Anglicized as follows:

<sup>1</sup>The latter two courtesy of F. Martin Brown.

Wings darkly fuscous, with purple iridescence, middle unules marginally dark fuscous; fore wings with black spots. Fore wings below ochraceous with black spots; hind wings cinereous with thin black spots.

Something like our *hiere* but smaller and in size similar to the preceding. The fore wings of the male are of a brownish tinge washed with fawn and with a violet reflection, and a small discoidal, blackish lunule at the edge; the wings above are marked with black spots; below in the anal angle is a small area with a trace of fawn lunules. The hind wings above are pale yellow-ochre, with black spots; below ashy gray with black spots in the lunules, transversely arranged; on the hind edge there is a series of sagittate whitish spots cut with black. The female is a lively yellowish fawn, spotted with black as in other species. This pretty species inhabits the high mountains of the Utah border in June and July.

The description of *zeroe* follows that of *nivalis* in Boisduval's paper, so that his statement that *zeroe* "se rapproche par la taille de l'espèce précédente" is comparing the *size* of the two. And it is obvious that this description of *zeroe* would fit *mariposa* quite well, as the secondaries of the latter are certainly "ashy gray" below. One cannot help wondering if imperfect translation of these descriptions caused Edwards to list *nivalis* as a synonym of *mariposa*, and Wright to figure *nivalis* and call it *zeroe*.

In view of the above information the present synonymy appears to be correct.

## VARIABILITY

The genus *Lycaena* includes a number of species that are quite variable as attested by the names given to subspecies as well as the names that have become synonyms. *L. nivalis* is no exception and its variability may well be due to its occurrence under widely differing climatic conditions. This is made possible by the distribution of its major food plant, *Polygonum douglasii*, in both the Transition and Boreal Zones, at elevations of at least between 2,000 and 7,500 feet, and where annual precipitation ranges from about 15 inches to 60 inches or more.

Brown (1957) reports that in Colorado *nivalis* frequents sage-brush flats and is rarely found along streams. In Oregon the writer has taken it at 7,000 feet on the slopes of Mt. Ashland; in a lush meadow at 4,000 feet in Linn County; in rather dry yellow-pine areas at 5,000 to 6,000 feet in the Ochoco and Maury Mountains in Crook County; and in somewhat similar areas at 6,000 to 7,500 feet in the Warner Mountains in Lake County. In Washington it may be found in canyons at relatively low elevations and also on mountain slopes and in high meadows. So variability is probably inevitable.

Material from Tombstone and Lost Prairies has a very intense coloration, the yellow and pink of the under side being brilliant, and the fawn color of the upper side of the females in very sharp contrast to the fuscous spots and margins. The same coloration occurs on material from Mt. Ashland, where precipitation would be at least 40 inches, and to a considerable extent on material from Harts Pass in northern Washington where the precipitation is high.

Specimens from the Ochoco and Maury Mountains, on the other hand, have a much less intense coloration, the ground color beneath, even in fresh specimens, being a washed-out light cream, with a tinge of pinkish on the secondaries, but no evidence of yellow. The color of the males above is somewhat less intense, and the females have a considerable smoky suffusion above. Here the spring rainfall is light and the annual not over 20 inches. Material from the Warner Mountains is similar to that from the Ochocos, except that the females are more melanic. Precipitation there is probably 20 to 25 inches.

Specimens from Satus Pass and Bear Canyon have rather contrasting yellow and pink coloration below, not as intense as on specimens from the Oregon Cascades, but much brighter than on the Ochoco material. Satus Pass females have perhaps less smoky suffusion, on the whole, than those from Bear Canyon. It should be pointed out that in the areas where intense coloration occurs, there would be less sunlight than in the areas where the colors beneath are less intense, and this may be a factor in determining the intensity of the colors.

Mean temperatures have been examined, particularly those of May and June, which might be expected to have the most effect. The highest temperatures occur in the southern part of the area and they decrease to the north. This does not match up with the difference in the coloration. And, as can be seen in the table, elevation is probably not a factor.

Lacking experimental data, no explanation is evident for the color variations found in *nivalis*, other than those suggested here.

#### SUMMARY OF VARIETIES

There are four rather distinct varieties of *nivalis* in the area under discussion:

1. Typical *nivalis*, mostly pinkish below with some black spots on the secondaries; the females with much yellow or

orange above. Sierra Nevadas, California, and Ochoco and Maury Mountains, Oregon. Fig. 1a.

2. Similar, but females very melanic above and black spots on secondaries below more pronounced. Warner Mountains, Oregon. Fig. 1b.

3. Typical *browni*, females with some orange above to very melanic; contrasting pink and yellow below and black spots on secondaries much reduced or absent. Utah to Washington. Fig. 1c.

4. Similar below, but colors much more intense, the pink contrasting strongly with the yellow; black spots reduced or obsolete; the females above with very little melanism, the orange ground color contrasting greatly with the fuscous spots and margins. Cascade Mountains of Oregon, specifically Linn and Jackson Counties. Fig. 1d.

The writer is not a taxonomist, but if *browni* is a valid subspecies, it would seem that this Cascade Mountain variety could legitimately be named as another subspecies, particularly as the conditions under which it occurs are very different from those elsewhere.

#### LIFE HISTORY

The writer described the early stages of *nivalis* more than 50 years ago (Newcomer, 1911). Unfortunately, for identification of the species, he had access only to the color plates of West Coast butterflies issued by Wright (1907) after the plates of his book on the same subject had been destroyed in the San Francisco earthquake and fire of 1906. And since Wright figured *nivalis* and called it *zeroe*, this writer described the early stages as those of *zeroe*. Adults were collected at the time and were later given to the California Academy of Sciences in San Francisco. Dr. C. Don MacNeill, Assistant Curator, has very kindly looked these up and he writes about them as follows: "I find a short series of your specimens of both *L. nivalis* and *L. mariposa* from the Lake Tahoe region. Of your material of *L. nivalis* one male and one female each bear an additional hand-penned label stating 'zeroe.' . . . All of your material of *L. mariposa* came from 5-Lakes<sup>2</sup> and none of the specimens bear a 'zeroe' label."

Later writers, not realizing the misidentification, have consistently said that the early stages of *nivalis* were unknown.

<sup>2</sup>These lakes are at an elevation of 7500 feet, while Deerpark, where *nivalis* was taken, is at 6500 feet. Both are just south of the Squaw Valley ski area.

Brown (1957) has indicated the range of the subspecies *browni* to be southeastern Wyoming, northwestern Colorado and across southern Idaho; and in a later paper (1961) he has extended this range to include Washington. In the original description, DosPassos (1938) mentioned Wyoming, Utah, Idaho and the Methow Valley in Washington. Typical *nivalis* occurs in California and up into Oregon.

The subspecies *browni* occurring in Yakima County, Washington, differs from those collected elsewhere in that the upper side of the females is usually entirely or almost entirely darkened by a smoky suffusion that obscures the normal yellowish fawn ground color. (Since the original description says "females are very melanic on the upper side," it may be assumed that this smokiness occurs elsewhere.) Brown, in his 1961 paper, surmised that this might be due to greater humidity in this area.

A study of the Weather Bureau's climatological data indicates that humidity does apparently affect the coloration but not in the way suggested by Brown. From available weather records and with some interpolation, the approximate precipitation in inches at some of the localities where *nivalis* occurs may be given (Table 1). Most of the precipitation in all of these localities would be in the form of snow and hence, in addition to the annual, records are given for April to June, as that would be the time when larvae and pupae would be present and the precipitation then would come mostly as rain.

TABLE 1

Locality	Elevation	Precipitation in Inches			
		April	May	June	Annual
Lakeview, Lake Co., Oreg.	4800	1.2	1.5	1.4	14
Ochoco Mts., Crook Co., Oreg.	5000	1.2	2.4	1.5	19
Tombstone Prairie, Linn Co., Oreg.	4000	3.5	4.3	1.0	90
Satus Pass, Klickitat Co., Wash.	3700	2.2	1.2	0.2	26
Bear Canyon, Yakima Co., Wash.	3000	1.0	0.8	1.2	19
Methow Valley (Winthrop), Okanogan Co., Wash.	3200	0.7	1.0	1.3	14
Harts Pass, Okanogan Co., Wash.	5500	6.0	4.0	3.0	85

The writer found females of *nivalis* (*zeroe*) ovipositing on *Polygonum douglasii* at Deerpark, near Lake Tahoe, California, in July 1909. He took them to Palo Alto and the eggs hatched the following February. Since *douglasii* was not available there, he tried related plants and succeeded in rearing some of the larvae on a species of *Rumex*. The young larvae ate pits in the leaves of this plant but older ones devoured the leaves entirely.

Since the Canadian Entomologist is generally available in libraries, it will not be necessary to repeat the rather long description of the early stages here. A brief summary should suffice for those who do not have access to the original descriptions.

*Egg*—Diameter, 0.85 mm. Depressed spheroid, ornamented with deep, polygonal pits; color pale bluish.

*Larva*—Four instars; newly hatched a little over 1 mm. in length; full-grown, 17 mm. Slug-shaped, brownish yellow when first hatched; later becoming pale green with a dorsal line of rose or claret color; a narrow whitish line on each side of it; cervical shield sunken on full-grown larvae, in the shape of a double diamond; dorsal and lateral hairs brownish; dorsum covered with small, white, hairless tubercles. Head dark brown.

*Pupa*—Length 10.5 - 11 mm. Rather stout, but longer for its breadth than usual with lycaenid chrysalids. Color at first very pale yellowish-green with a pinkish dorsal stripe; later pale straw-yellow with some brown spots. Hairs, resembling miniature trumpets, scattered thickly on dorsum of head and more sparingly on thorax and abdomen, appearing like minute tacks stuck into the skin.

In July, 1962, the writer saw a female *nivalis* ovipositing on a small, more or less dried-up plant near Satus Pass, Washington. This plant proved to be *Polygonum douglasii*,<sup>3</sup> an annual. The <sup>3</sup>Determined from Abrams "Illustrated Flora of the Pacific States," vol. II, Stanford Univ. Press, Stanford, Calif., 1944. area in Bear Canyon, west of Yakima, Washington, where *nivalis* is particularly abundant, was immediately examined, and plants of *P. douglasii* were found. This species occurs from British Columbia to the mountains of southern California and east to the Rocky Mountains. It is sometimes the dominant annual in high, open prairies. Later, it was found growing wherever *nivalis* was flying in Washington and Oregon, and it is, as previously mentioned, probably the major food plant of the species.



The adults of *nivalis* frequent the flowers of yarrow (*Achillea millefolium*), woolly-sunflower (*Eriophyllum lanatum*), spiraea, and occasionally others in the vicinity of the larval food plant.

Females were collected alive and put in plastic ice-cream cups with the food plant; and eggs were deposited on the plant and also on the sides of the containers. These eggs were kept over winter outdoors but they did not hatch. Probably this was due either to lack of moisture or to too much cold. The winter temperature got as low as  $-3^{\circ}\text{F}$ . In the natural habitat the wintering eggs would almost always be covered with snow during the cold weather and would therefore not be subject to temperatures much below freezing. Probably the eggs could be carried through successfully in a refrigerator.

Thus we see that this single-brooded species passes about eight months of its life in the egg stage which is subjected to the heat of summer,—and the eggs would often be on or near dry ground in full sunlight,—the cold of autumn and the “refrigeration” of winter. They would also be subjected to considerable extremes of moisture during that time. And when the snow has gone, the newly hatched larvae must seek out the seedling plants sprouting from seeds produced by the plants on which oviposition occurred. And yet the species is successful and is quite common at times.

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